

Agenda
Arapaho National Wildlife Refuge
Initial Meeting with United States Fish & Wildlife Service
July 18, 1995

I. Review USF&WS's Statement of Work

- A. Objective
- B. Deliverables by W. W. Wheeler & Assoc.
- C. *Materials to support application*
~~Schedule~~
Soon for field work

*Possibly change in season
old = May → July
new = earlier to later*

II. Review W. W. Wheeler's Scope of Work

III. Availability of Information or Documents to be provided by USF&WS

- A. Copies of Water Rights decrees. - *ginger thought she provided*
- B. Copies of annual water use information. *theyll come to look at files*
- C. Mylar's of Base Maps. *Computer / Mylar*
- D. Previous reports on ANWR
- E. Aerial Photographs
- F. Available information of previous owners of water rights

IV. Identification of Key Personnel

- A. Phone Numbers
- B. Fax Numbers
- C. Address

V. Identification of Primary Contacts

- A. USF&WS
- B. Wheeler
- C. Sellards & Grigg

Gene Patten

Private Lands Agreements
include requirement that
the Platte R depletions
are read to be restored
under "other" water right
source, etc.

All "new" ^{appaho} Refuge ponds
have complied as well -
with quantifying depletion
& offsetting

^{currently}
Undergoing Review of Refuge
for consultation.

ARAPAHOE NATIONAL WILDLIFE REFUGE

PROPOSED SCOPE OF WORK WATER RIGHTS ANALYSIS HISTORIC Vs. CURRENT PRACTICES

PART I. HISTORIC USE ANALYSIS

General. The primary objective of Part I of the Scope of Work is to quantify the amount of stream depletion (consumptive use) attributable to the historic irrigation practices on lands now held by the U. S. Fish and Wildlife Service (USFWS) for the Arapahoe National Wildlife Refuge (ANWR). The irrigated acreage at the ANWR is estimated to be in excess of 10,000 acres and is served by approximately 25 individual water rights. It is proposed to approach the historic use analysis in a manner consistent with water resource engineering practices performed for water rights transfers or change of use proceedings in the Colorado Water Courts. By adopting this approach, it will enable the FWS to evaluate potential changes in the operation and use of the ANWR water rights to facilitate the purposes of the refuge, without causing injury to other water users and water rights in the North Park area. If it is ultimately decided by the FWS to change the location or pattern of use of a water right(s), the necessary historic use data will be complete.

The proposed scope of work for W. W. Wheeler and Associates, Inc. (Wheeler) is summarized in the following outline.

Subtask 1 - Initial Meetings with USFWS.

- A. Meet with USFWS staff to review the Scope of Work and to generally review the intent of the project and the approach to the historic use analysis proposed by Wheeler. It is assumed that USFWS will provide all information related to the amount of land included in the ANWR, the water rights held by the USFWS for the ANWR and all available prior reports pertaining to the water rights and their historic use. Two half-day meetings are anticipated.

Subtask 2 - Review of Prior Reports.

- A. Review all reports provided by the USFWS related to the historic use of the ANWR water rights, including available detailed summaries of the direct flow water rights and the reservoir storage rights held by the FWS. Prepare a project memorandum summarizing the date of each report reviewed, the general subject matter of the report and the key data contained therein.
- B. Obtain copies of the court decrees for the ANWR water rights, including any changes of use decrees that may have been granted by the courts. Review the decrees to identify any particular concerns or conditions that may affect the use of the water rights at the ANWR.

Subtask 3 - Water Right Diversion Records.

- A. Consult with the Colorado Division of Water Resources, specifically the Division 6 Engineer and the local Water Commissioner in regard to the availability of reliable records of the historic diversions by the ANWR water rights. Depending on the availability and reliability, select a study period that extends back in time to at least 15 years prior to the initial acquisition of lands for the ANWR (approximately 1950) and carries through 1993. Prepare a brief memorandum summarizing the availability of records and providing a recommendation to the FWS in regard to the selected study period, based on the reliability of the data.
- B. Obtain the available diversion and reservoir storage records from the Colorado Division of Water Resources. Summarize the river headgate diversion data on a monthly and annual basis for each of the ANWR ditch and reservoir structures.
- C. Convert monthly diversion data from the spreadsheet format to ASCII files for subsequent use in computerized depletion models.
- D. Summarize the historic reservoir release data, if available, to determine the timing of releases and the quantity of storage water historically used for each irrigated parcel.

Subtask 4 - Delineation of Historic Irrigated Acreage.

- A. Obtain aerial photo coverage of the irrigated portions of the ANWR from available sources, including the USFWS, the ASCS, the SCS and the USFS. If available, the preferable photography would include one coverage in the late 1960's and another in the early 1990's (*the latter to be used for the analysis of current irrigation practices at ANWR*). Black and white photography will be used for the earlier coverage and color photography, if available, will be used for the later coverage.
- B. Scale the aerial photographs against USGS 1:24,000 topographic quad maps to establish the photo scale.
- C. Prepare acetate/mylar overlays for the photos for subsequent identification of irrigated areas.
- D. In conjunction with the field inspections described in Subtask 5, identify the location of the ANWR ditch structures, major laterals, and reservoirs on the photo overlays.
- E. In conjunction with the field inspections described in Subtask 5, identify the areal extent of the historically irrigated acreage under each ditch structure and outline on the photo overlays. Planimeter each parcel to determine acreage for each ditch structure.

- F. Prepare a table summarizing the amount of historically irrigated acreage under each ditch. Prepare a map at an approximate scale of 1" = 2,000 ft. which shows the location of the ditch structures and the irrigated acreage.

Subtask 5 - Field Investigations

- A. Perform detailed site inspection of the ditch structures and reservoirs associated with the ANWR. Perform a reconnaissance level evaluation of the ditch capacities in relation to the decreed flow rates and historic diversions. Identify and assess the adequacy of the measuring devices on each structure. Verify the location of ditch headgates and the general alignment of the ditches on the aerial photographs.
- B. Using the aerial photos, identify the location and areal extent of the historically irrigated acreage under each ANWR ditch and reservoir. Determine which structure (ditch and/or reservoir) is available as a source of irrigation water to each parcel.
- C. Inspect the existing storage reservoirs and ponds associated with the water rights on the ANWR. Separately identify all natural ponds on the refuge.
- D. Analyze the soil properties for the ANWR irrigated lands by comparison of data summarized in the SCS Soil Surveys for Jackson County with observations made in the field using shallow, hand-augered test holes.
- E. Determine depth to water table under the subject irrigated parcels in order to evaluate the potential contribution to the consumptive use from high water table conditions.
- F. Evaluate and to the extent possible, determine the patterns of surface runoff and potential interception by other ditches prior to reaching the stream. Similarly, evaluate the probable locations of subsurface return flows with respect to other ditch headgates.
- G. Conduct on site interviews with former owners and/or irrigators of the ranch properties now included in the ANWR to gain understanding of historic irrigation practices, including typical season of use (first day and last day of diversions); the methods of irrigating; the timing of harvest; hay production versus irrigated pasture grass; estimated crop yields; adequacy of the diverted water supply; operation of storage reservoirs (when filled, when released, refill opportunities, etc.); verification of irrigated areas; and any other related information.
- H. Interview the local Water Commissioner to gain understanding about the administration of water rights and storage rights in the North Park area; the typical hydrology of the rivers and streams through the ANWR; and knowledge as to historic uses on the ANWR.

Subtask 6 - Reservoir Evaporation Losses

- A. Using procedures described in National Weather Service Technical Paper NWS-33, estimate the annual evaporation loss from shallow ponds and reservoirs.
- B. Using procedures recommended by the Colorado State Engineer, determine the monthly distribution of the annual evaporation determined in Item A. above.
- C. From aerial photographs, determine the surface area of the man-made reservoir and ponds on the ANWR. Estimate the average annual water surface area with consideration of typical drawdown patterns.
- D. Estimate the monthly evaporation loss from all man-made reservoirs and ponds using the monthly net evaporation rates and the estimated water surface areas.

Subtask 7 - Determine Aquifer Properties and Return Flow Patterns

- A. Establish aquifer properties necessary to evaluate the timing of subsurface return flows from irrigation. To the extent available, use well test reports, published information from the USGS and/or other agencies to estimate saturated thickness of the aquifer, hydraulic conductivity and void ratios.
- B. Using maps of the ANWR, estimate the distance of the irrigated parcel from the surface stream system, expressed in terms of the "L" distance used in the generally accepted Glover procedure for return flow analysis.
- C. As appropriate, identify the location of intercepted surface runoff and intercepted groundwater return flows.

Subtask 8 - Summarize Soil Properties

- A. Using the SCS Soil Survey maps, supplemented with data obtained during the field inspections, determine the characteristics of the soils including depth of soil, soil moisture holding capacity, infiltration rates, etc. Determine a weighted average of the soil characteristics for each major ditch structure.

Subtask 9 - Crop Irrigation Requirement (CIR)

- A. Obtain daily temperature and precipitation data from the weather station at Walden for the selected study period.
- B. From field inspections and interviews, identify the type and nature of the crop raised on the irrigated parcels (assumed to be predominantly meadow hay grass).

- C. Set up the model to determine the Crop Irrigation Requirement (CIR) using a computer model developed by Wheeler (SMBGW). The CIR represents the amount of irrigation water required by a crop, after the contribution from natural precipitation. The SMBGW model estimates CIR in comparison to the evapotranspiration (ET) for a "reference crop".
- D. The estimated CIR will be verified using a calibrated Blaney Criddle equation with crop coefficients for high mountain meadow grass developed from lysimeter studies in the South Park area of Colorado.

Subtask 10 - Historic Depletion Analysis

- A. Model the historic irrigation practice using Wheeler model DPLN5-WT or WTMDL. This model(s) compares the theoretical CIR with the available irrigation supply as indicated by the historic diversion records and storage releases. The model also includes consideration of the available water stored in the soil profile that is available for consumption by the plant. *(Note that a portion of the groundwater contribution may be from natural conditions not related to diversions pursuant to the ANWR water rights.)*
- B. Input the historic diversion data from Subtask 3, adjusted for ditch conveyance losses and contributions from intercepted runoff from upgradient ditches, if any.
- C. Input the CIR requirement from Subtask 9.
- D. Input the return flow characteristics determined in Subtask 7.
- E. Summarize the results of DPLN5-WT model for each ditch. For each water right structure, provide a monthly summary of the historic use of the water right, including the following:
 - 1. Estimates of historic monthly diversions and modeled irrigation return flows.
 - 2. Estimates of historic monthly **Stream Depletion**, defined as diversions minus return flows. (The Stream Depletion is a measure of the impact on the stream resulting from the historic irrigation practices. It differs from Consumptive Use because of the delayed timing effects of subsurface return flows.)

PART II. CURRENT USE OF WATER RIGHTS FOR WILDLIFE

General. The primary objective of Part II of this Scope of Work is to quantify the amount of water diverted, consumptive uses (crop evapotranspiration and evaporation losses), return flow patterns and stream depletions attributable to the current and anticipated uses of the ANWR water rights for wildlife purposes in the refuge. The approach will be very similar in technique to that described in Part I, the Historic Use Analysis, modified as necessary to reflect differences, if any, resulting from a change in the timing of diversions, changes in the location of irrigated parcels, combining or commingling water rights, transferring water rights to different structures, change in the season of use, etc.

Much of the basic data needed for the Current Use Analysis is developed in Part I and is more fully described in that portion of the Scope of Work.

Subtask 11 - Evaluation of Current Management Practices

- A. Review the *Annual Water Use Report/Management Plans* available from the USFWS for the period 1979 through 1993 to gain understanding of the goals and objectives of the Management Plan for the ANWR.
- B. During the field inspections described under Subtask 5 of Part I, conduct interviews with the Supervisor/Manager of the ANWR to review the current management policies and desired operations of the water rights and water features of the ANWR and to identify differences between the current (and anticipated) operations for wildlife enhancement and the historic practices of agricultural irrigation.
 - 1. Determine if new and additional lands are desirable for irrigation under the current management plan. Compare the locations of these new irrigated areas, if any, to the historically irrigated parcels.
 - 2. Determine if new ponds or other open-water features are to be incorporated into the ANWR management plan. If so, evaluate sources of supply to those facilities.
 - 3. Evaluate possibilities of diversions in a seasonal time frame different from that for historic agricultural irrigation.

Subtask 12 - Current Diversion Practices

- A. Using the available Water Use Reports/Management Plan provided by the USFWS, summarize the current diversion records for each structure on a monthly and annual basis.
- B. Verify the USFWS records by comparison to the diversion records maintained by the local Water Commissioner.

- C. Prepare summary showing the "pre-refuge" diversions used for agricultural irrigation in comparison to the "post-refuge" diversions used for wildlife. Evaluate differences in the timing of diversions for the two uses, the magnitude of diversions and any differences in the use of storage water.
- D. In consultation with the Water Commissioner, determine if any changes in the pattern/timing of diversions (if identified in Item C above) could cause injury to other water rights and water users downstream. This may entail an analysis of the "pre and post" refuge impacts on the streamflow as measured at USGS stream gages downstream.
- E. Consider whether changes in the amount and/or timing of diversions would impact the provisions of the interstate compact between the States of Colorado, Wyoming and Nebraska which governs the diversion and use of the water in each state.

Subtask 13 - Delineation of Current Acreage and Structures

- A. In consultation with the ANWR Manager, identify current acreage irrigated using the subject water rights and compare to the mapping of the historic irrigated acreage. This work will be verified during the field inspections (Subtask 5 of Part I) and mapped on overlays using the more recent aerial photographic coverage. If planned, identify any additional acreage that might be brought under irrigation in the future for wildlife enhancement purposes.
- B. Identify any new diversion structures or conveyance facilities that may be included in the current operation of the ANWR.
- C. Delineate and planimeter the current irrigated acreage as determined above, including an estimate of planned future irrigation, if any.
- D. Prepare a summary describing the amount of current irrigated acreage under each ditch and reservoir. Prepare a map at an approximate scale of 1" = 2,000 ft. which shows the location of the current ditch structures and the irrigated acreage.

Subtask 14 - Review Soil Characteristics and Aquifer Properties

- A. As described in Subtasks 7 and 8 of Part I, review the soil characteristics and aquifer properties pertinent to new irrigated acreage, if any, to determine differences from the assumptions used for the historic use analysis in Part I.

Subtask 15 - Analysis of Pond Evaporation

- A. After consultation with the ANWR Manager, determine operational practices for existing and new water storage facilities. Determine typical and projected water storage levels throughout the season, when used for wildlife purposes.

- B. Using estimates of the monthly net evaporation, compute annual evaporation losses from ponds and reservoirs under the current wildlife practices.

Subtask 16 - Crop Irrigation Requirement

- A. After understanding the current irrigation practices at ANWR, evaluate whether any modifications to the estimates of the Consumptive Irrigation Requirement (CIR), as determined in Subtask 9 of Part I, are justified. Implement those modifications as necessary.

Subtask 17 - Return Flow Patterns

- A. After understanding the current irrigation practices at ANWR, evaluate whether any modifications need to be made to the pattern and timing of irrigation return flows.

Subtask 18 - Current Depletion Analysis

- A. Model the current irrigation practices at ANWR to estimate the Stream Depletion using Wheeler's DPLN5-WT or WTMDL models, as described in Subtask 10 of Part I. Utilize the diversions, irrigated acreage, CIR, return flow characteristics, etc., associated with the current irrigation operations at ANWR.
- B. Summarize the results of the DPLN5-WT model for each ditch. For each water rights structure, provide a monthly summary of the current (and anticipated future) use of the water right, including the following:
 1. Estimates of the current diversions and modeled irrigation return flows, both of which would reflect any change in the timing of diversions for wildlife uses.
 2. Estimates of the Stream Depletion attributable to the current operational practices.
- C. Prepare a summary illustrating the differences, if any, between the historic stream depletion patterns (Subtask 10 of Part I) and the depletion patterns under the current wildlife operational practices.

Subtask 19 - Final Report

1. Prepare a final written report, documenting the analyses used to quantify the impacts of the historic and current irrigation practices for lands now included in the ANWR. The report will contain detailed documentation of the diversions, consumptive use, return flows, evaporation losses and net stream depletion for each condition.
2. Meet with USFWS personnel to discuss the results of the analysis and to evaluate recommendations for further actions by the USFWS.